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**SIMPLIFIED ANTENNA CONTROLLER SYSTEM  
OPERATION MANUAL**

Job Order 17-069

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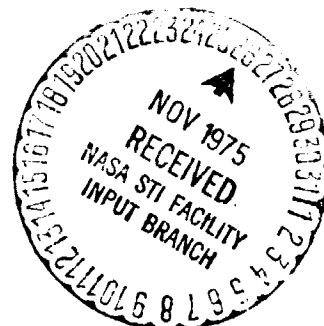
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Houston, Texas

Contract NAS 9-12200

For

SPACECRAFT SYSTEMS TEST OFFICE  
TRACKING AND COMMUNICATIONS DEVELOPMENT DIVISION



*National Aeronautics and Space Administration*  
**LYNDON B. JOHNSON SPACE CENTER**  
*Houston, Texas*

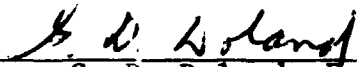
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SIMPLIFIED ANTENNA CONTROLLER SYSTEM  
OPERATION MANUAL

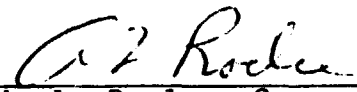
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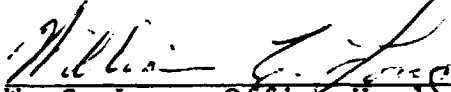
  
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# **TECHNICAL REPORT INDEX/ABSTRACT** (See instructions on reverse side.)

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<p>This document provides a description and the necessary information to operate the Simplified Antenna Controller.</p>		
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George D. Doland of the Spacecraft Systems Test Section of Lockheed Electronics Company, Inc., designed the Simplified Antenna Controller System, coordinated fabrication and prepared this Operation Manual. The Simplified Antenna Controller with the exception of the Antenna Power Supply was manufactured by Lockheed Electronics Company, Inc., fabrication facility located in the Alpha building.

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## 1. INTRODUCTION

The purpose of this document is to describe the Simplified Antenna Controller and provide the information necessary to properly operate the equipment to control a specific seven-element phase array antenna procured by the National Aeronautics and Space Administration/Johnson Space Center.

### 1.1 SYSTEM COMPONENTS

The Simplified Antenna Controller System consists of the Simplified Antenna Controller, Antenna Power Supply, Junction Box, and Antenna Test Points unit. This system was constructed as an interim system for which a computer controlled antenna controller is being constructed. The design philosophy was to construct the simplest possible unit in the shortest possible time which would serve the purpose. The antenna power supply is also a component of the calculator controlled antenna controller. To operate the system, a 28-volt supply at 1 ampere is required.

### 1.2 SIMPLIFIED ANTENNA CONTROLLER

The entire system is operated from the Simplified Antenna Controller. This unit contains switches to energize the controller system, switches to energize each element of the seven-element phased array antenna, and switches to control the phase of the radio frequency signal for each of the six elements of the antenna which can be controlled.

### 1.3 ANTENNA POWER SUPPLY

The antenna power supply contains a 22-volt supply to power the transmitters in the antenna, a 12-volt supply to control the receivers in the antenna, and a 5-volt supply for the digital logic in the antenna. The antenna power supply is remotely controlled from the Simplified Antenna Controller using the 28-volt source from the controller to energize the system. Digital logic

signals are 5 volts nominal and generated in the controller. Power is not applied to the antenna (or antenna test points) until the antenna power switch on the controller is placed in the ON position.

#### 1.4 JUNCTION BOX

The junction box contains seven relays to control 12-volt power to the seven antenna elements. It also contains wiring to interconnect the various input connectors to the single output connector to the antenna or antenna test points.

#### 1.5 ANTENNA TEST POINTS

This unit is provided for test purposes and provides a test point for every signal applied to the antenna. Internal loads are provided for each supply except the 22-volt transmitter power. If this unit is to be tested under load, an external 3.5-ohm resistor with a rating of at least 150 watts is required.

#### 1.6 MAINTENANCE

If maintenance of the unit is required, this will be provided by the Spacecraft Systems Test Office support personnel.



## 2. SYSTEM DESCRIPTION

The antenna test point unit is provided simply as a test unit and as a simple means of adjustment of the various voltages. It may also be used to verify proper operation of the controller system by substituting the antenna test point unit for the antenna.

### 2.1 SYSTEM CABLING

All switches should be placed in the OFF position and the system cabled as shown in figure 1. Even though 115 volts primary power is applied to the antenna power supply, it will not be operative until the 28-volt power is applied and remotely controlled from the controller.

### 2.2 PHASED ARRAY ANTENNA ELEMENTS

Several different numbering systems have been used for identification of the phased array antenna elements. To avoid any possible confusion, the phase array antenna elements are numbered as shown in figure 2 for this controller.

### 2.3 PIN ASSIGNMENTS

To verify that the antenna and controller are compatible at the mating connector, table I is provided which identifies each signal at each connector pin. The connector pin assignments are correlated with the antenna element designations of figure 2.

### 2.4 RUNNING TIME METERS

The controller has three chemical running time meters with a range of 1,000 hours each. When the controller power switch is energized, the corresponding running time meter is operating. A similar arrangement is used for the antenna power supply and the antenna. The antenna is not energized until the antenna power switch is placed in the ON position even though the antenna power supply is ON.

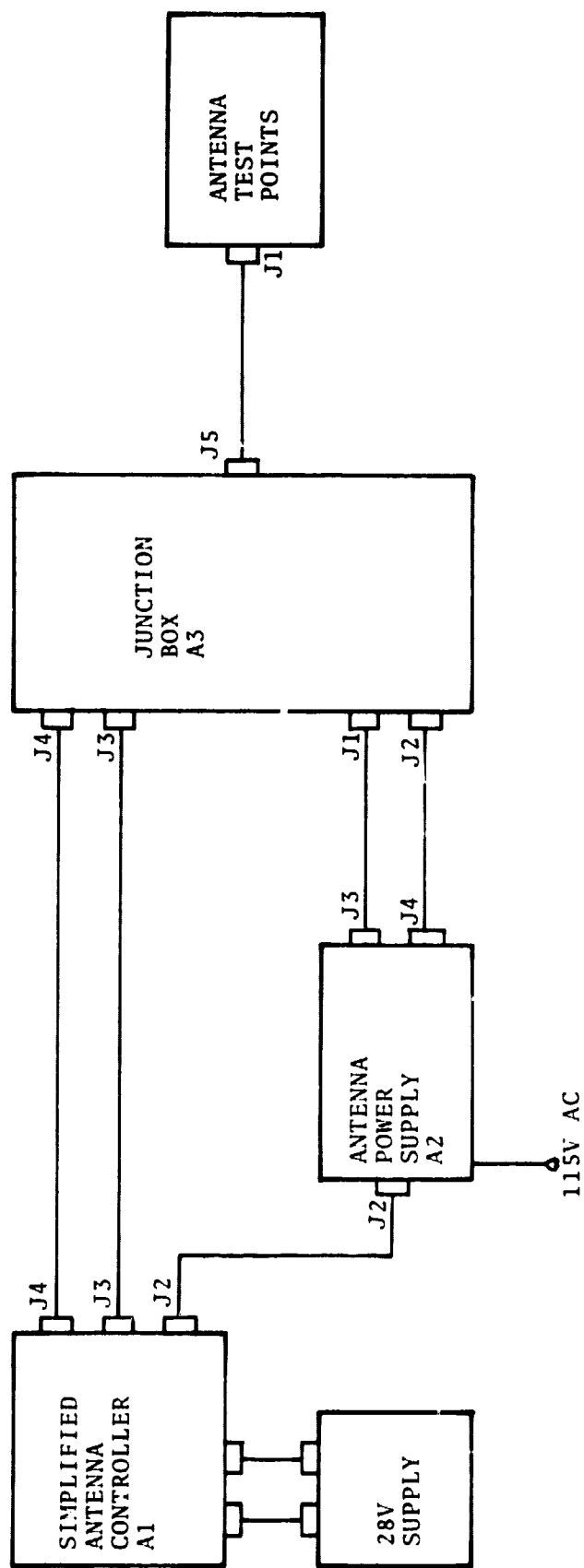


Figure 1. - System cabling.

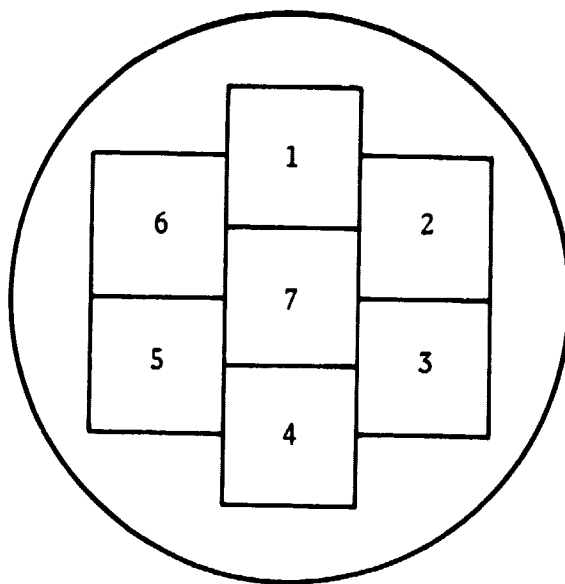


Figure 2. — Phased Array antenna elements.

TABLE I. - PIN ASSIGNMENTS

<u>Identification</u>	<u>Pin</u>
12-Volt Element Power 1	R
12-Volt Element Power 2	B
12-Volt Element Power 3	C
12-Volt Element Power 4	S
12-Volt Element Power 5	V
12-Volt Element Power 6	U
12-Volt Element Power 7	<u>e</u>
Transmit Gate 1	K
Transmit Gate 2	M
Transmit Gate 3	L
Transmit Gate 4	H
Transmit Gate 5	F
Transmit Gate 6	G
Receive Gate 1	a
Receive Gate 2	$\bar{N}$
Receive Gate 3	b
Receive Gate 4	$\bar{Z}$
Receive Gate 5	E
Receive Gate 6	Y
Logic +5 Volt	D
Logic Ret	J
+22 Volt	A
+22 Volt	P
+22 Volt	<u>d</u>
Regulated Ret	T
Regulated Ret	f
Phasor Bit 45°	c
Phasor Bit 90°	$\bar{h}$
Phasor Bit 180°	<u>g</u>
Spare	W
Spare	<u>i</u>
MS 3122E18-32S Bulkhead Connector	
MS 3126E18-32S Cable Connector	

### 3. OPERATING PROCEDURE

The Simplified Antenna Controller has been tested prior to delivery, however, it is recommended that the controller be tested first with the antenna test point unit and that the pin assignments be compatible.

#### 3.1 ENERGIZING THE SYSTEM

Cable the system as per figure 1 with all switches in the OFF position. Apply 28 volts to the Simplified Antenna Controller and verify this voltage. Place the controller power switch in the ON position and verify the voltage is 28 volts using the meter switch and meter on the controller. Place the antenna power supply switch to the ON position. This will energize the antenna supply. The voltages are to be checked with the meter switch and meter on the controller. If all are correct, the antenna power switch is placed in the ON position. This will apply power to the antenna or antenna test points, whichever is connected to the system.

#### 3.2 ENERGIZING THE ANTENNA ELEMENTS

To energize an antenna element, the element power switch is placed in the ON position. Usually all elements are energized except for special test, therefore, all seven of these switches are placed in the ON position.

#### 3.3 ENABLING ANTENNA CONTROL

Ordinarily, the antenna pointing is controlled by the phase settings applied to each antenna element. However, if there is a failure in the phase control signals to the antenna, boresite operation can be achieved by placing the enable switch in the OFF position. It is then necessary to switch each transmitter and receiver gate switch to the ON and then OFF position. When this sequence is complete, the antenna pointing is at boresite. For normal operation, the enable switch is placed in the ON position.

### 3.4 ANTENNA POINTING CONTROL

To achieve a specific antenna pointing angle, it is usually preferable to have a table of phasor settings for each element for transmit and receive. It is also preferable to set the controls in sequence from one to six.

Place the three phase control switches in the ON position as required in obtaining the desired phase angle. Phase angles are obtainable at  $0^\circ$  and  $45^\circ$  increments. When the desired phase position is set for transmit element 1, the transmit gate switch for element 1 should be turned ON and then OFF. This sequence is repeated for each transmit and receive element. When all transmit and receive element have been gated by the ON/OFF sequence, the antenna steering is complete.

### 3.5 ANTENNA POINTING CHANGES

If the antenna pointing has been set at some desired pointing angle and a change in position is desired, this can be accomplished by changing only the phase of the elements requiring a change. Place the phase control switches to the new desired phase angle for some specific transmit or receive element. Then place the gate switch for this particular element in the ON and then OFF position. This sequence is repeated for each element where a new phase angle is desired or required.